

SUPPORT FOR THE AMENDMENTS

Claim 14 is amended to include the description from Claim 15.

Claim 15 is canceled.

Claim 16 is amended to depend from Claim 14.

No new matter will be added to this application by entry of this amendment.

Upon entry of this amendment, Claims 14,16, 18, 19, 21, 22, 24 and 26 are active.

REMARKS/ARGUMENTS

The claimed invention is directed to a quartz glass crucible for the preparation of silicon single crystal via a method such as the Czochralski process. The claimed invention provides a quartz glass crucible as described in Claim 14 and claims dependent thereon.

Applicants respectfully note that Claim 14 is herein amended to include the description from Claim 15 that the transparent coated layer on at least the inside surface is obtained by coating a silica sol liquid comprising a metal salt and a partial hydrolyzate of an alkoxysilane oligomer on at least the inside and/or the outside surface of the crucible, and heating a crucible coated with the silica sol liquid to form a transparent coated layer comprising a crystallization promoter derived from said metal salt. No such quartz glass crucible is disclosed or suggested in the cited references.

The rejection of Claims 14-16, 18-19 and 21-22, 24 and 26 under 35 U.S.C. 103(a) over Hansen et al. (U.S. 5,980,629) in view of Watanabe et al. (U.S. 6,106,610) is respectfully traversed.

Hansen is directed to a process for preparing a silicon melt for pulling a single crystal by the Czochralski method comprising loading granular polycrystalline silicon into a crucible of vitreous silica having a bottom wall and a sidewall formation extending up from the bottom wall and defining a cavity for holding the molten semiconductor material, with a first

devitrification promoter being on the inner surface of the sidewall formation (Claim 1, in part). The first devitrification promoter is deposited on the inner surface of the crucible sidewall formation at a temperature below 600°C (Col. 2, lines 65-67). This deposit is such that, during “the Czochralski process, in general, and the melting of the polysilicon, in particular, stable crystal seed nuclei form at these nucleation sites and the vitreous silica at the crucible surface crystallizes, . . .”(Col.4, lines 21-25).

Applicants have described the problems associated with a crucible treated in the conventional manner as described by Hansen, beginning on page 1, last paragraph and bridging to page 2. Since the devitrification promoter is not fixed on the quartz glass crucible, the adhesion strength of that layer is very weak and the devitrification promoter powder is easily abraded and falls off during handling. The crucible cannot be washed because the devitrification powder would be removed in this process. As a result of handling and possible cleaning, the amount of devitrification promoter adhering to the crucible surface becomes nonuniform across the surface and nucleation efficiency is degraded.

Applicants have demonstrated significant improvement in performance of a crucible according to the claimed invention over a crucible according to Hansen in Tables 3, 4 and 6 of the specification. Example 8 which represents a crucible treated with Ba Carbonate powder in a manner similar to that described by Hansen provides inferior performance in surface hardness (Table 3), crystallization rate and layer thickness (Table 4) and rate of crystallization on repeated usage.

The Office has acknowledged that Hansen does not teach the crystallization promoter is dispersed in a silica matrix (Official Action dated July 11, 2008, page 3, line 3).

Watanabe is cited to show a method of forming a crystallization promoter layer containing the promoter in a translucent quartz glass layer. The Office states (Official Action

dated July 11, 2008, page 3, line10) that the description of Watanabe reads on the claimed crystallization promoter dispersed in a silica matrix.

Applicants respectfully note that according to the amendment to Claim 14 described above, the crystallization promoter layer is formed by a sol-gel method and therefore the following advantages are obtained according to the invention which are not obtained by any combination of Hansen and Watanabe:

- 1) A uniform concentration of crystallization promoter is obtained in the silica sol formed layer.
- 2) The silica sol formed layer has a strength such that the crystallization promoter does not dissolve in the silicon melt during the silicon single crystal pulling-up process.
- 3) The uniform concentration of crystallization promoter in the strong surface causes the formation of a uniform cristobalite layer on the crucible surface during the silicon single crystal production.

In contrast, Watanabe, and consequently the combination of Watanabe and Hansen, if these descriptions are combined, uses a mixture of a crystallization accelerator and a powder of silicon dioxide. In such a method, Applicants respectfully submit that microscopic nonuniformity results and the uniform and strong layer obtained through the combined hydrolysis and condensation polymerization of the sol-gel method according to the invention is not obtained.

The Office has stated (Official Action dated July 11, 2008, page 4, lines 14-17):

“As to a crystallization promoter uniformly dispersed, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Hansen et al and Watanabe et al by dispersing the promoter uniformly because having uniform properties would have been desireable.”

However, Applicants respectfully submit that neither reference provides any suggestion or motivation that would have led one of ordinary skill in the art at the time of the invention to prepare a crystallization promoter containing layer in a sol gel according to the claimed invention.

Applicants respectfully call the Examiner's attention to the following excerpt from the Office's own discussion of "**Examination Guidelines for Determining Obviousness Under 35 U.S.C. 103 in View of the Supreme Court Decision in *KSR International Co. v. Teleflex Inc.***"

"The rationale to support a conclusion that the claim would have been obvious is that **all the claimed elements were known in the prior art** and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination would have yielded nothing more than predictable results to one of ordinary skill in the art at the time of the invention.⁴³ "[I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does."⁴⁴ **If any of these findings cannot be made, then this rationale cannot be used to support a conclusion that the claim would have been obvious to one of ordinary skill in the art,"** (Federal Register, Vol. 72, No. 195, page 57529) (**Bold added**)

Moreover, Watanabe requires a further layer coating the crystallization promoter containing layer in order to prevent contamination of the silicon single crystal.

Hansen **requires** a layer of crystallization promoter **in direct contact with melted polysilicon** and Watanabe requires the crystallization promoter **not be in direct contact with the melted polysilicon**. The cited references clearly teach opposite requirements and therefore Applicants respectfully submit that one cannot be an improvement of the other.

Applicants respectfully continue to disagree with the Office's position that the rejection can be supported as an improvement of the Hansen crucible by combining with only a part of the Watanabe disclosure.

The MPEP § 2143 C, under the heading “Use of Known Technique To Improve Similar Devices (Methods, or Products) in the Same Way” states:

“To reject a claim based on this rationale, Office personnel must resolve the Graham factual inquiries. Then, Office personnel must articulate the following:

(1) a finding that the prior art contained a “base” device (method, or product) upon which the claimed invention can be seen as an “improvement;”

(2) a finding that the prior art contained a “comparable” device (method, or product that is not the same as the base device) **that has been improved in the same way as the claimed invention;**

(3) a finding that **one of ordinary skill in the art could have applied the known “improvement” technique in the same way to the “base” device (method, or product)** and the results would have been predictable to one of ordinary skill in the art; . . .” (Bold added)

Applicants respectfully submit that the Watanabe crucible is described in Col. 6, lines 25-33, as follows:

“Thus , because the impurity which functions as the crystallization promoter is not brought into contact with the silicon melt, the incorporation of an impurity into the silicon single crystal can be prevented from occurring. Accordingly, the present invention is also effective in suppressing the generation of crystal defects.”

Applicants respectfully submit that Watanabe neither discloses nor suggests improvement by forming an inner layer of the crucible wherein the crystallization promoter is uniformly dispersed in a silica matrix as described in Claim 14. Moreover, Applicants respectfully submit that as the reference clearly describes that the crystallization promoter **should not be in contact with the silicon melt**, it would not have been obvious to one of ordinary skill in the art to apply the description of a non-exposed inner crystallization promoter layer of Watanabe to the surface layer of Hansen.

MPEP § 2143 (G) states that to reject a claim based on a combination of references to arrive at the claimed invention, Office personnel must articulate:

“(1) a finding that there was some teaching, suggestion, or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings; . . .”

Moreover, Applicants respectfully submit that one skilled in the art would recognize that such a thin layer, i.e., less than 1 μm would not be obtained by the Watanabe process since the coating of the SiO_2 -metal oxide mixed layer is done by arc plasma scattering at a temperature of 1800°C (Col. 2, lines 34-46). At such a high temperature, the diffusion rate is so fast that such a thin layer would rapidly diffuse, and as a consequence, obtaining the structure of the claimed invention would not be possible.

Applicants respectfully disagree with the Office's position that the declaration does not compare the closest prior art and is therefore insufficient to overcome the rejection of claims 14-16, 18-19, 21-22, 24 and 26.

Watanabe is cited as a secondary reference in combination with Hansen. The significant improvement according to the claimed invention relative to Hansen is described above. Watanabe requires a coating over the crystallization promoter containing layer and therefore this reference cannot be compared to the claimed invention. In his declaration, Mr. Tsuji describes that an advantage of the invention is an extremely thin layer of concentrated crystallization promoter which provides the significant performance improvement described in Tables 3-6 in the specification. Applicants respectfully submit that Mr. Tsuji's declaration does describe significant improvement over the prior art according to the claimed invention.

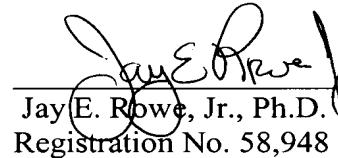
Based on the foregoing, Applicants respectfully submit that the cited combination of references neither anticipates, renders the claimed invention obvious. Accordingly, withdrawal of the rejection of Claims 14-16, 18-19 and 21-22, 24 and 26 under 35 U.S.C. 103(a) over Hansen in view of Watanabe is respectfully requested.

Application No. 10/720,122
Reply to Office Action of July 11, 2008

Applicants respectfully submit that the above-identified application is now in condition for allowance and early notice of such action is earnestly solicited.

Respectfully submitted,

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